NEW TOOL PROMISES SMALLER, FASTER COMPUTER CHIPS

Can You Imagine . . .

. . . a chip-making tool that uses extreme ultraviolet light to print lines as small as 0.1 microns, shaving more than two-thirds off current minimum dimensions.

The semiconductor industry has targeted ever-smaller circuits in its drive toward faster computer chips that pack more memory into less space. But those miniaturization goals make integrated circuit (IC) manufacturers face a task equivalent to painting a thin line with a thick brush.

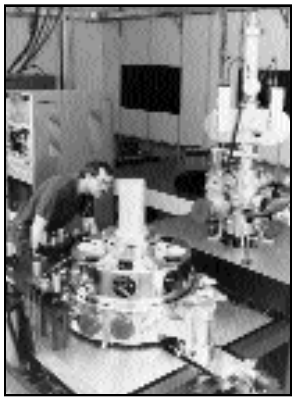
In a recent advance, Sandia National Laboratories (SNL; Livermore, CA) and AT&T Bell Laboratories developed a new research tool that produces chips with features below 0.1 microns—three times smaller than today's best feature sizes. IC manufacturers did not expect to achieve this precision until the year 2007. Smaller feature sizes will result in ICs with higher memory density, higher performance capabilities, and lower energy consumption rates.

SNL'S RESEARCH TOOL PRODUCES FEATURE SIZES BELOW 0.1 MICRONS, A FEAT OF PRECISION THAT IC MANUFACTURERS DID NOT EXPECT TO ACHIEVE UNTIL 2007.

In a recent test, Sandia printed the world's first working microelectronic device that uses extreme ultraviolet light lithography (EUVL). The device, a field-effect transistor and a common building block of all integrated circuits, features an electrical channel (or gate width) of 0.10 microns—one thousandth the width of a human hair. To further evaluate and develop EUVL technology, the researchers plan to create more complicated devices and circuits.

SNL researchers are also investigating the possibility of using the EUVL tool to print some of the world's smallest holograms. The nanometer-scale holograms could form the basis of a new security system that would use holographic "microtags" to brand everything from computer chips to currency to compact discs. The advantages of the microtag lie in both its size and complexity. Its sub-0.2 micron features make the microtag difficult to find and replicate, frustrating chip counterfeiters who bombard computer integrators with forgeries. Its physical orientation provides another security feature: Only read-out equipment that illuminates the microtag at the correct incidence angles can discover its true identity.

This technology grew out of a BMDO program in which SNL developed a laser plasma source of extreme ultraviolet radiation. BMDO needed this EUVL source, intended for classified studies of detector performance and material survivability at these wavelengths, as an alternative to synchrotrons, which were not approved for classified research.



■ Mechanical technician Yon Perras inspects the extreme ultraviolet light lithography tool, which etches fine patterns in silicon chips.

ABOUT THE TECHNOLOGY

Lithography transfers microscopic device patterns onto silicon wafers, level by level. Shrinking device dimensions continue to push traditional optical lithography systems to the limits of fine resolution between the circuit elements. An EUVL system, using shorter wavelength light than traditional systems, can overcome the optical resolution problems inherent when the device feature size approaches the wavelength of the light used.

SNL's EUVL source uses a laser striking a solid metal target to create a plasma of ions. When these ions lose their energy, they emit a broad spectrum of radiation centered in the extreme ultraviolet region. A monochrometer filters out unwanted light and helps choose the wavelength best suited for a particular application.